

FORM PTO-1390 (Modified) (REV 10-95)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER 199202US2XPCT	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 09/700729	
INTERNATIONAL APPLICATION NO. PCT/JP00/02060		INTERNATIONAL FILING DATE 31 March 2000		PRIORITY DATE CLAIMED 31 March 1999	
TITLE OF INVENTION SHOVEL					
APPLICANT(S) FOR DO/EO/US Hideki KINUGAWA, et al.					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<ol style="list-style-type: none"> <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1). <input type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c) (2)) <ol style="list-style-type: none"> <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). <input checked="" type="checkbox"/> has been transmitted by the International Bureau. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)). <input checked="" type="checkbox"/> A copy of the International Search Report (PCT/ISA/210). <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)) <ol style="list-style-type: none"> <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> have been transmitted by the International Bureau. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. <input checked="" type="checkbox"/> have not been made and will not be made. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). <input type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409). <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)). 					
Items 13 to 18 below concern document(s) or information included:					
<ol style="list-style-type: none"> <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. <input type="checkbox"/> A substitute specification. <input type="checkbox"/> A change of power of attorney and/or address letter. <input type="checkbox"/> Certificate of Mailing by Express Mail <input checked="" type="checkbox"/> Other items or information: 					
<p>Request for Consideration of Documents Cited in International Search Report</p> <p>Notice of Priority PCT/IB/304 PCT/IB/308 Drawings (5 Sheets)</p>					

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 09/700729	INTERNATIONAL APPLICATION NO. PCT/JP00/02060	ATTORNEY'S DOCKET NUMBER 199202US2XPCT	
20. The following fees are submitted.		CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : <input checked="" type="checkbox"/> Search Report has been prepared by the EPO or JPO \$860.00 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) \$690.00 <input type="checkbox"/> No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$710.00 <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1000.00 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00			
ENTER APPROPRIATE BASIC FEE AMOUNT =		\$860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)).		□ 20 □ 30 \$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	17 - 20 =	0	x \$18.00 \$0.00
Independent claims	1 - 3 =	0	x \$80.00 \$0.00
Multiple Dependent Claims (check if applicable).		□	\$0.00
TOTAL OF ABOVE CALCULATIONS =		\$860.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable).		□ \$0.00	
SUBTOTAL =		\$860.00	
Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)).		□ 20 □ 30 + \$0.00	
TOTAL NATIONAL FEE =		\$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).		□ \$0.00	
TOTAL FEES ENCLOSED =		\$860.00	
		Amount to be refunded \$ charged \$	
<input checked="" type="checkbox"/> A check in the amount of \$860.00 to cover the above fees is enclosed. <input type="checkbox"/> Please charge my Deposit Account No. in the amount of to cover the above fees. A duplicate copy of this sheet is enclosed. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 15-0030 A duplicate copy of this sheet is enclosed.			
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.			
SEND ALL CORRESPONDENCE TO: <div style="border: 1px solid black; padding: 10px; text-align: center;">  22850 Surinder Sachar Registration No. 34,423 </div>			
 SIGNATURE Marvin J. Spivak NAME 24,913 REGISTRATION NUMBER 1130-00 DATE			

199202US2XPCT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF : :

HIDEKI KINUGAWA ET AL : ATTN: APPLICATION DIVISION

SERIAL NO: NEW U.S. PCT APPLICATION :
(BASED ON PCT/JP00/02060)

FILED: HEREWITH : :

FOR: SHOVEL

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Prior to a first examination on the merits, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, line 1, delete "SPECIFICATION" and insert therefor

- TITLE OF THE INVENTION

line 3, delete "TECHNICAL FIELD" and insert therefor

BACKGROUND OF THE INVENTION

Field of the Invention--

line 5, delete "BACKGROUND" and insert therefor

--Discussion of the Background--.

Page 3, between lines 4 and 5, insert

--SUMMARY OF THE INVENTION--;

line 9, delete in its entirety.

Page 4, line 6, delete in its entirety and insert therefor

--DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

IN THE CLAIMS

Please amend the claims as follows:

Claim 4, line 1, change "any of claims 1 to 3" to --claim 1--.

Claim 6, line 1, delete "or 5".

Claim 7, line 1, change "any of claims 1 to 3" to --claim 1--.

Please add new Claims 8-17 as follows:

--8. The excavator according to claim 2, wherein in the operating part provided with a hydraulic actuator, a hydraulic pump is driven by the electric motor, and said hydraulic actuator is operated by oil from said hydraulic pump.

9. The excavator according to claim 3, wherein in the operating part provided with a hydraulic actuator, a hydraulic pump is driven by the electric motor, and said hydraulic actuator is operated by oil from said hydraulic pump.

10. The excavator according to claim 8, wherein as the hydraulic actuator in the operating part, a traveling hydraulic motor and a turning hydraulic motor are provided on the lower traveling body and the upper turning body, respectively, and oil from the hydraulic

pump driven by one electric motor is selectively supplied to either said traveling hydraulic motor or said turning hydraulic motor.

11. The excavator according to claim 9, wherein as the hydraulic actuator in the operating part, a traveling hydraulic motor and a turning hydraulic motor are provided on the lower traveling body and the upper turning body, respectively, and oil from the hydraulic pump driven by one electric motor is selectively supplied to either said traveling hydraulic motor or said turning hydraulic motor.

12. The excavator according to claim 8, using an electric motor-pump integrated type actuator in which the electric motor and the hydraulic pump in which a discharging direction of oil is converted according to the turning direction of said electric motor.

13. The excavator according to claim 9, using an electric motor-pump integrated type actuator in which the electric motor and the hydraulic pump in which a discharging direction of oil is converted according to the turning direction of said electric motor.

14. The excavator according to claim 10, using an electric motor-pump integrated type actuator in which the electric motor and the hydraulic pump in which a discharging direction of oil is converted according to the turning direction of said electric motor.

15. The excavator according to claim 11, using an electric motor-pump integrated type actuator in which the electric motor and the hydraulic pump in which a discharging direction of oil is converted according to the turning direction of said electric motor.

16. The excavator according to claim 2, wherein turning force of the electric motor is reduced by a reduction unit to apply it as the driving force the operating part.

17. The excavator according to claim 3, wherein turning force of the electric motor is reduced by a reduction unit to apply it as the driving force the operating part.--

IN THE ABSTRACT

Please delete the original Abstract sheet page 15 in its entirety and insert therefor

--ABSTRACT OF THE DISCLOSURE

An excavator in which a generator is driven by an engine as a power source. Electric motors are driven by electric power supplied from the generator, and a lower traveling body, an upper turning body, and operating parts of an excavation attachment are operated by the electric motors.--

REMARKS

Favorable consideration of this application, as presently amended, is respectfully requested.

The present preliminary amendment is submitted to place the above-identified application in more proper format under United States practice. By the present preliminary amendment the specification has been amended to include suggested headings. The claims have been amended to no longer recite any multiple dependencies. The subject matter of the canceled multiple dependencies has now also been presented in new dependent Claims 8-17. A new Abstract believed to be in more proper format under United States practice is also submitted herein.

The present application is believed to be in condition for a full and thorough examination on the merits. An early and favorable consideration of the present application is hereby respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
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SPECIFICATION

SHOVEL

TECHNICAL FIELD

The present invention relates to an excavator as an excavation machine using an electric motor as a driving source.

BACKGROUND

In the past, a general excavator called a hydraulic excavator is constituted so that an upper turning body is mounted on a lower traveling body (normally, a crawler), and an excavation attachment provided with a boom, an arm and a bucket is mounted on the upper turning body, whereby a hydraulic pump is rotated by an engine, as a driving source, installed on the upper turning body to supply its discharge oil to a hydraulic actuator (a hydraulic motor or a hydraulic cylinder) to effect traveling, turning, boom rising and falling, arm operation, and bucket operation.

However, the aforementioned conventional hydraulic type excavator has a problem that a burden applied to the engine is great, fuel cost is high, and exhaust gases and noises are involved.

In view of the above, there has been proposed a so-called hybrid type in which an electric motor is rotated by an engine, and a hydraulic pump is driven by the electric motor, as disclosed in Japanese Utility Model Application Laid-Open No. Hei 5 (1993)- 4850 Publication.

The above-described well known hybrid type excavator is designed so that when the pump load is light, the electric motor is allowed to function as a generator by surplus torque of the engine (regenerative function) to store

power in a battery, whereas at the time of heavy load, the engine is assisted by the stored power of the battery, thus smoothing the engine load, reducing the exhaust gases and reducing the fuel cost.

However, according to the above-described well known hybrid type excavator, since the turning force is transmitted through a channel of the engine - electric motor - hydraulic pump, it is necessary to mechanically connect these three elements, and collecting the latter at one place as a single power unit and installing them.

This poses the following disadvantages:

(1) The power unit is large, and a large space is required for the installing part (upper turning body), these points impede the arrangement of devices, which is unsuitable for a small turning type excavator which recently becoming the main current.

(2) The variation of load of the excavator is particularly sever in terms of

time and level as compared with an automobile or the like so that switching of the mechanical connecting parts of the power unit is frequently carried out, thus posing a great problem in terms of responsiveness and durability of the power unit.

(3) As a problem in terms of oil pressure, the following occur:

(a) The distance between the hydraulic pump of the power unit and the hydraulic actuator installed at each operating part of the excavator is so long that pressure loss is great;

(b) Energy loss particularly at the time of fine operation is great due to the bleed off from a control valve (a switching valve) provided between the pump and the actuator; and

(c) A pilot hydraulic source (a pump) for the pilot control of the control valve is also necessary.

As described, the energy loss of the hydraulic system is large, and the actual effect of improving fuel cost is low.

Thus, the present invention provides an excavator in which a power unit can be installed by being divided and scattered at a small unit, frequent switching of the mechanical connecting parts of the power unit is not required, and the energy efficiency of the engine can be improved.

DISCLOSURE OF THE INVENTION

For solving the aforesaid problem, the present invention employed the following constitution.

That is, an excavator in which an upper turning body is mounted on a lower traveling body, and an excavation attachment is provided on the upper turning body, comprising an engine as a power source, a generator driven by the engine, and a plurality of electric motors rotated by electric power supplied from the generator, whereby the electric motors as a driving source operate the lower traveling body, the upper turning body and each operating part of the excavation attachment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an entire schematic side view of an excavator according to a first embodiment of the present invention.

FIG. 2 is a circuit representation of an electric motor and a pump integrated type actuator used for the excavator.

FIG. 3 is a block constitutional view of a driving and control system

of the excavator.

FIG. 4 is a view corresponding to FIG. 3 of an excavator according to a second embodiment of the present invention.

FIG. 5 is a view corresponding to FIG. 3 of an excavator according to a third embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

First Embodiment (see FIGS. 1 to 3)

FIG. 1 shows an entire excavator according to this embodiment.

In the figure, reference numeral 1 denotes a lower travel body; 2 an upper turning body; and 3 an excavation attachment mounted on the front part of the upper turning body 2.

The lower travel body 1 comprises left and right crawler frames 4 and crawlers (in both of which, only one side is shown) 5, and both the crawlers 5 travel by being individually rotated and driven by left and right electric motors for traveling (see FIG. 3) 6 and 7.

The upper turning body 2 comprises a turning frame 8, a cabin 9 and so on. On the turning frame 8 are installed an engine 10 as a power source, a generator 11 driven by the engine 10, a battery 12 an electric motor for turning 13, a reduction unit 14 for reducing a turning force of the electric motor for turning 13 to transmit it to a turning mechanism (a turning gear), an electric motor for a boom 15, and a hydraulic pump for a boom (hereinafter referred to as boom pump) 16 rotated and driven by the electric motor for a boom 15.

The excavation attachment 3 comprises a boom 17, a boom cylinder 18 expanded and contracted the boom 17 by pressure oil from the boom pump

16, an arm 19, an arm cylinder 20 for turning the arm 18, a bucket 21, and a bucket cylinder 22 for operating the bucket 21.

In the excavation attachment 3, an electric motor 23 for an arm and a hydraulic pump for an arm (hereinafter referred to as an arm pump) 24 driven thereby, and an electric motor for a bucket 25 and a hydraulic pump for a bucket driven thereby (hereinafter referred to as a bucket pump) 26 are provided on the arm cylinder 20, and the bucket cylinder 22, respectively.

Units of the electric motor for a boom 15 and the boom pump 16, of the electric motor for an arm 23 and the arm pump 24, and of the electric motor for a bucket 25 and the bucket pump 26 are constituted as well known integrated type actuators A1, A2 and A3, respectively.

The constitution of the integrated type actuators A1, A2 and A3 is shown in FIG. 2.

As shown in the figure, the pumps 16, 24 and 26 are respectively constituted as bi-directional pumps in which an oil discharging direction is converted according to a turning direction of the electric motors 15, 23 and 25, and both discharge ports of the pumps 16, 24 and 26 are connected to oil chambers on the head side and the rod side of the cylinders 18, 20 and 22 through pipes 27 and 28.

In FIG. 2 reference numerals 29, 29 denote a relief valve; 30 an oil tank; 31 automatic switching valves provided between the pump 16, 24, 26 and the oil tank 30; 32, 32 operate check valves; 33 manual open-close valves provided between both the pipes 27 and 28; and 34, 34 slow return valves.

By employing the integrated actuator constitution, the entire unit can be miniaturized and light-weighted as compared with the case where the electric motor and the pump are separately provided. Therefore, it is

advantageously mounted on the excavation attachment 3.

FIG. 3 shows the block constitution of a driving system and a control system of the excavator.

In the figure, the solid line, the dotted line, and the phantom outline indicate an electric driving system, an electric circuit, and a hydraulic driving system, respectively. In the figure, reference numeral 35, 36 denote reduction units for left and right electric motors for traveling 6, 7.

An inverter 37 is provided between the generator 11, each of the electric motors 6, 7, 15, 23, 25 and a battery 12. By the inverter 37,

(1) AC power prepared by the generator 11 is converted into DC for storage in the battery 12 (normal charging operation),

(2) AC power generated in the electric motors 6, 7, 15, 23 and 25 is converted into DC by regenerative operation resulting from the excavator operation for storage in the battery 12 (regenerative charging operation), and

(3) Stored power in the battery 12 is converted into AC and supplied to the electric motors 6, 7, 15, 23 and 25 (discharging operation).

The inverter 37 is provided with a switching means not shown whereby the charging and discharging operations are switched by operation of an operator or according to the load condition.

The electric motors 6, 7, 15, 23 and 25 are controlled in turning speed and turning direction by, for example, an operating means of a lever operating type not shown which is operated by an operator.

The driving and control operations for the excavator including the above-described operations (1) to (3) will be described hereinafter.

When the engine 10 is operated, the generator 11 is driven to carry out generating operation, and the electric motors 6, 7, 15, 23 and 25 are

driven by AC power generated.

Thereby, power is transmitted to the excavation attachment 3 through a driving channel of the electric motors 15, 23, 25 - pumps 16, 24, 26 - cylinders 18, 20, 22, and power is transmitted to the lower traveling body 1 and the upper turning body 2 through a driving circuit of the electric motors 6, 7, 13 - reduction units 35, 36, 14 for operation (excavation, traveling, turning).

Basically, the electric motors 6, 7, 15, 23, 25 are driven by power supplied via the inverter 37 from the generator 11, but under heavy load, by operation of the switching means, short of power is compensated by the stored power of the battery 12, while under light load, surplus power of the generator 11 is stored in the battery 12.

During operation, the electric motors 6, 7, 15, 23, 25 are operated as a generator (regenerative operation) making use of position energy and kinetic energy thereof whereby the regenerative power generated can be stored in the battery 12. Particularly, the electric motors 15, 23, 25 provided on the excavation attachment 3 are so high in position energy and kinetic energy that the stored effect is high. It is therefore possible to reduce consuming energy and minimize the battery 12.

On the other hand, where the load is light, and the battery capacity is sufficient, output of the engine 10 is lowered, or the engine is stopped, and the electric motors 6, 7, 15, 23, 25 can be driven merely by battery power.

By such an operation, the engine load can be smoothed, the noise and exhaust gases can be reduced, and the fuel cost can be reduced..

According to this excavator, the turning force is transmitted through the channel of the engine 10 - generator 11 ...electric motors 6, 7, 15, 23, 25,

as described above, the mechanical coupling being merely for the engine 10 and the generator 11. The power unit is divided into a set of engine 10 + generator, and the electric motors 6, 7, 15, 23, 25, and the former can be installed on the upper turning body 2 while the latter can be installed on various operating parts (the lower traveling body 1, the upper traveling body 2, and the excavation attachment). Accordingly, since a large installation space collected at one place is not necessary, and this is suited, particularly, for a small turning type excavator.

Further, various operating parts are driven by the electric motors 6, 7, 15, 23, 25, and the generator 11 can be connected to the electric motors 6, 7, 15, 23, 25 by an electric wiring, thus enabling considerable reduction of transmission loss of energy.

Second Embodiment (See FIG.4)

Only the difference from the first embodiment will be described.

In the first embodiment, each operating part of the excavation attachment 3, i.e., the boom 17, the arm 19, and the bucket 21 are operated through the channel of the pumps 16, 24, 26 - hydraulic cylinders 18, 20, 22, whereas in the second embodiment, the boom 17, the arm 19 and the bucket 21 are operated directly mechanically by the electric motors 15, 23, 25 and the reduction units 37, 38, 39.

In this case, there can be employed the constitution in which the reduction unit output side is connected to the diametrically central part during turning of the boom 17, the arm 19 and the bucket 21.

By doing so, no hydraulic system is necessary, and the efficiency of power transmission is improved.

Third Embodiment (see FIG. 5)

In the actual operation, the "traveling" operation of the lower traveling body 1 and the "turning" operation of the upper turning body 2 are hardly carried out simultaneously.

The third embodiment has paid attention thereto to employ the constitution in which a traveling and turning electric motor 40 is used, so that a traveling and turning hydraulic pump 41 is driven by the electric motor 40, and pressure oil from the pump 41 can be supplied to left and right traveling hydraulic motors 43, 44 or a turning hydraulic motor 45 through a switching valve 42 to selectively perform the traveling and turning operation.

By doing so, two electric motors can be reduced, and the constitution of devices can be simplified.

While in the first embodiment, the integrated type actuators A1, A2, A3 in which the electric motors 15, 23, 25 for the boom, arm and bucket, and the pumps 16, 24, 26 driven thereby are integrated were used, it is noted that the electric motors 15, 23, 25 and the pumps 16, 24, 26 may be separately provided and connected mechanically.

Further, the present invention can be also applied to an excavator wherein in the excavation attachment 3, other working tools (for example, an earth removing plate and a crusher) are mounted in place of the bucket 21, an excavator which as the excavation attachment 3, is provided with a loading type for excavation from this side to the opposite side in place of a back hoe type for excavation toward this side as shown in FIG. 1, and an excavator which uses a wheel in place of a crawler as a lower traveling body.

As described above, the constitution is employed in which the generator is driven by the engine as a driving source, the electric motors are rotated by electric power supplied from the generator, and the lower traveling body and the upper turning body and the operating parts of the excavation attachment are operated by the electric motors, and therefore, only the engine and the generator will suffice for the mechanical connection.

That is, the power unit is divided into a set of engine + generator and electric motors, which can be installed separately (the former is the upper turning body, and the latter are the operating parts).

Therefore, a large installing space is not necessary at one place, and particularly, a small turning type excavator is suitably used.

Further, there is employed the constitution in which the operating parts are driven by the electric motors, and since the generator and the electric motors can be connected by the electric wiring, frequent switching of the mechanical connecting parts is not required, and the transmission loss of energy can be considerably reduced.

In this case, at the time of light load, electric power generated in the generator is stored in the battery while at the time of heavy load, a short of power of the generator is compensated for by the stored power of the battery, or is borne in place of the generator whereby the engine load of the excavator which is severe in variation of load can be smoothed to realize reduction in exhaust gases and reduction in fuel cost.

Further, by the provision of the constitution in which electric power generated by the regenerative control of the electric motors is stored in the battery, the stored effect is obtained, and particularly, the electric motors provided on the excavation attachment are high in stored effect because

position energy and kinetic energy can be used for the regenerative operation.

Because of this, the consuming energy can be reduced, and the battery can be miniaturized.

Further, by the provision of the constitution in which as the hydraulic actuators for the operating parts, the traveling hydraulic motor and the turning hydraulic motor are provided on the lower traveling body and the upper turning body, respectively, and oil from oil pressure driven by a single electric motor is selectively supplied to one of the traveling hydraulic motor and the turning hydraulic motor through the switching valve, one electric motor can be used in common for the "traveling" and "turning" which are rarely operated simultaneously.

Because of this, two electric motors can be saved, thus enabling simplification of constitution of devices, and reduction in costs of devices.

Furthermore, in the constitution in which the driving force is transmitted through the channel of the electric motor - hydraulic pump - hydraulic actuator, as described above, the electric motor/pump integrated type actuator is used whereby miniaturization and light-weight construction can be realized as compared with the case where these elements are provided separately and independently. Therefore, this is particularly suitable for one installed on the excavation attachment.

On the other hand, by the provision of the constitution in which the turning force of the electric motor is reduced by the reduction unit to apply it as the driving force to the operating parts, whereby no hydraulic system is required to thereby improve the transmission efficiency of energy.

INDUSTRIAL APPLICABILITY

As described above, according to the present invention, the installing space for the power unit can be reduced, and there can be obtained the useful effect which is advantageous particularly in the small turning type excavator.

CLAIMS

1. An excavator in which an upper turning body is mounted on a lower traveling body, and an excavation attachment is provided on the upper turning body, comprising an engine as a power source, a generator driven by the engine, and a plurality of electric motors rotated by electric power supplied from the generator, characterized in that the electric motors as a driving source operate the lower traveling body, the upper turning body and each operating part of the excavation attachment.
2. The excavator according to claim 1, wherein surplus electric power from the generator is stored in a battery, and the electric motors are driven by the electric power stored in the battery as necessary.
3. The excavator according to claim 2, wherein electric power generated by regenerative control of the electric motors is stored in the battery.
4. The excavator according to any of claims 1 to 3, wherein in the operating part provided with a hydraulic actuator, a hydraulic pump is driven by the electric motor, and said hydraulic actuator is operated by oil from said hydraulic pump.
5. The excavator according to claim 4, wherein as the hydraulic actuator in the operating part, a traveling hydraulic motor and a turning hydraulic motor are provided on the lower traveling body and the upper turning body, respectively, and oil from the hydraulic pump driven by one electric motor is selectively supplied to either said traveling hydraulic motor or said turning hydraulic motor.
6. The excavator according to claim 4 or 5, using an electric motor-pump integrated type actuator in which the electric motor and the hydraulic pump in which a discharging direction of oil is converted according to the turning

direction of said electric motor.

7. The excavator according to any of claims 1 to 3, wherein turning force of the electric motor is reduced by a reduction unit to apply it as the driving force the operating part.

ABSTRACT

A excavator in which a generator (11) is driven by an engine (10) as a power source, electric motors (6), (7), (15), (23) and (25) are driven by electric power supplied from said generator (11), and a lower traveling body, an upper turning body and operating parts of an excavation attachment are operated by said electric motors (6), (7), (15), (23) and (25).

F I G. 1

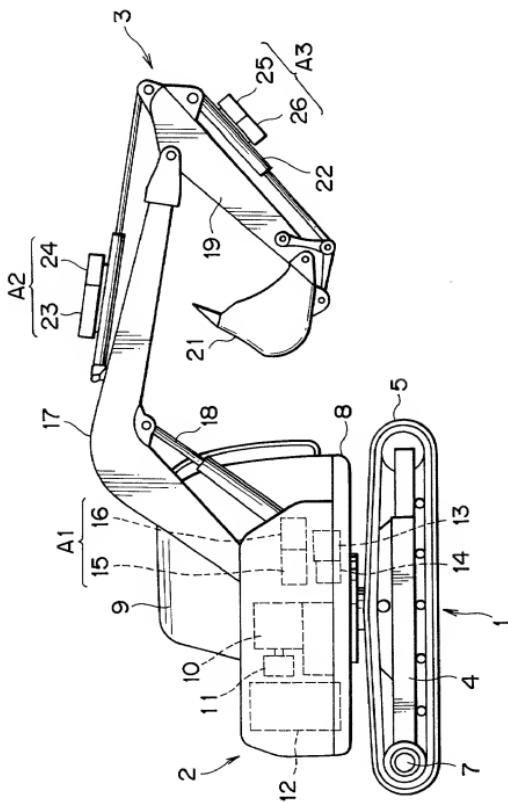


FIG. 2

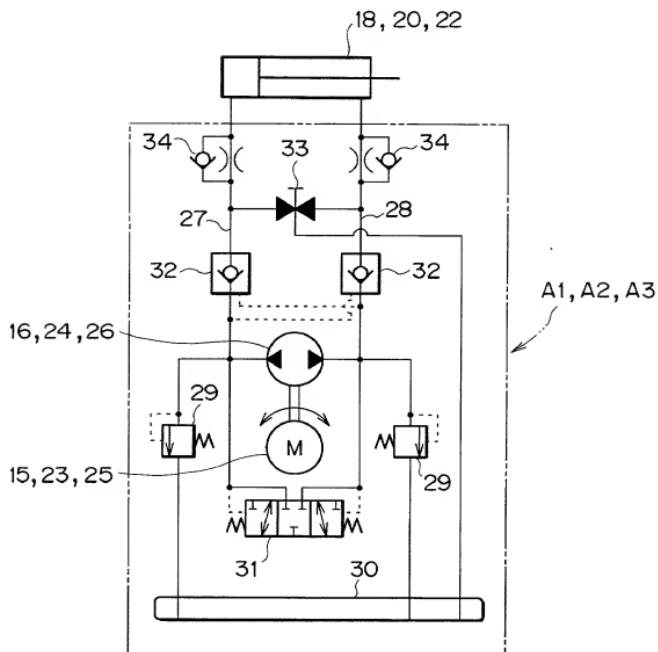


FIG. 3

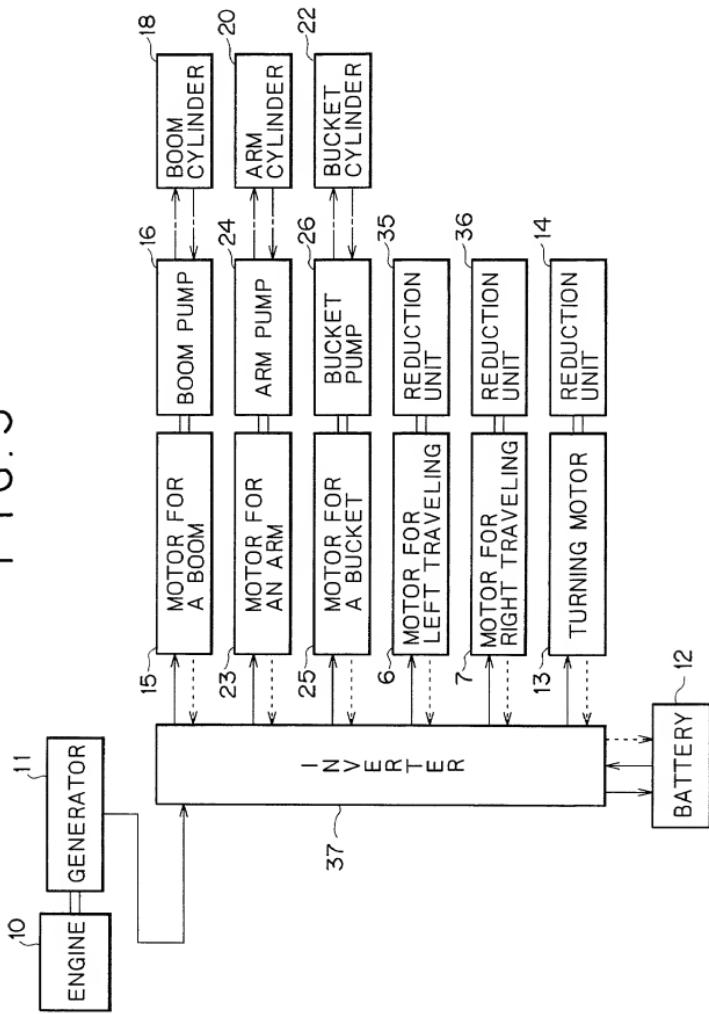


FIG. 4

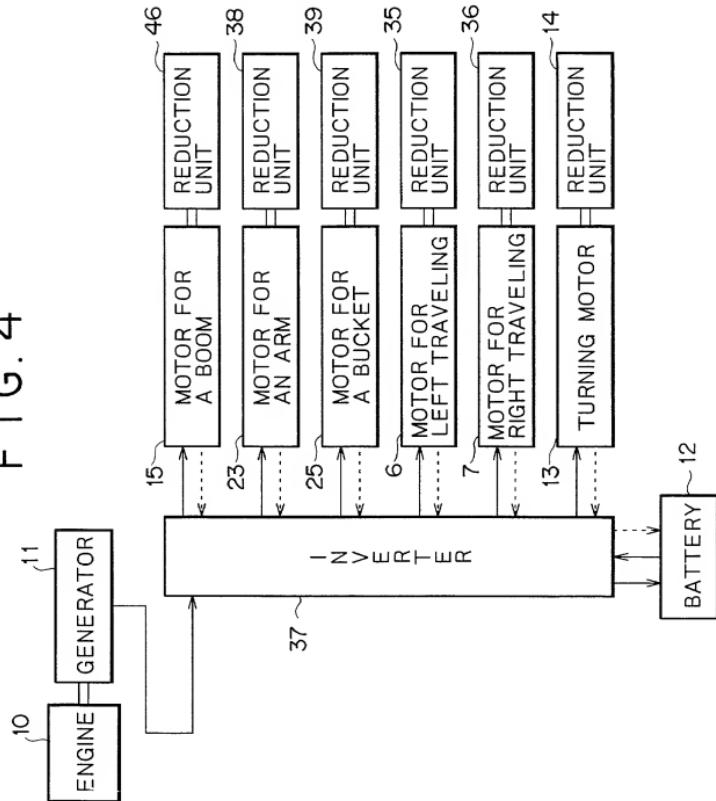
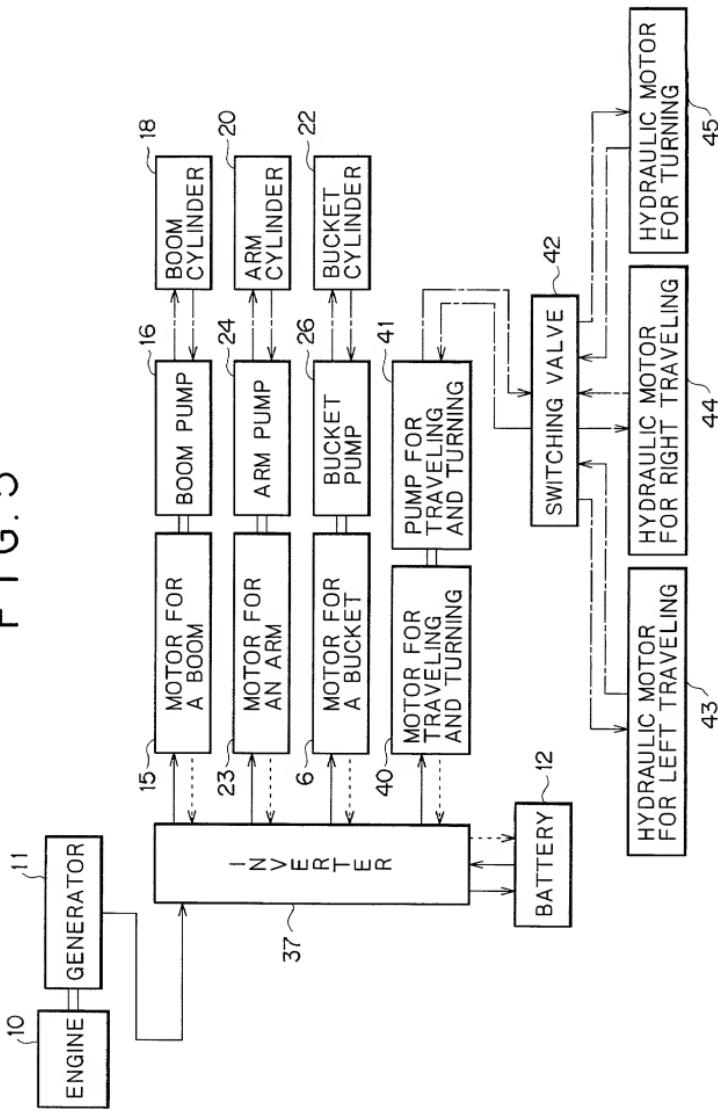


FIG. 5



Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

2007

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled,

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上記発明の明細書は、

本書に添付されています。
 ____月____日に提出され、米国出願番号または特許協定条約国際出願番号を_____とし、
(該当する場合) _____に訂正されました。

the specification of which

is attached hereto
 was filed on March 31, 2000
as United States Application Number
PCT International Application Number
PCT/JP00/02060 and was amended on
_____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification including the claims, as amended by any amendment referred to above

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulation, Section 1.56

Japanese Language Declaration

(日本語宣言書)

私は、米国法典第35編119条(a) - (d)項又は365条(b)項に基づき下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Application(s)

外国での先行出願

Number	Country	Month/Day/Year Filed	Priority Claimed
番号 0011-093178	国名 JP	出願年月日 March 31 1999	優先権主張 YES

私は、第35編米国法典119条(e)項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

(Application No.)	(Filing Date)
(出願番号)	(出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条(e)に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許権の有無に関する重要な情報について開示義務があることを認識しています。

(Application No.)	(Filing Date)
(出願番号) PCT/JP00/02060	(出願日) March 31 2000

私は、私自信の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により处罚されること、そしてそのような故意による虚偽の声明を行なえは、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のことく宣誓を致します。

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.)	(Filing Date)
(出願番号)	(出願日)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Status: Patented, Pending, Abandoned)
(現況:特許許可済、係属中、放棄済)

Patented Pending Abandoned

I hereby declare that all statements made herein of my own knowledge are true and that all statement made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration

(日本語宣言書)

・委任状：私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。
(弁護士、または代理人の指名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: (list name and registration number)

Normal F. Oblon, Registration Number 24,618; Mavin J. Spivak, Registration Number 24,913; C. Irvin McClelland, Registration Number 21,124; Gregory J. Maier, Registration Number 25,592; Arthur I. Neustadt, Registration Number 24,854; Richard D. Kelly Registration Number 27,757; James D. Hamilton, Registration Number 28,421; Eckhard H. Kuesters, Registration Number 28,870; Robert T. Pous, Registration Number 29,099; Charles L. Gholz, Registration Number 26,395; Vincent J. Sunderdick, Registration Number 29,004; Wilham E. Beaumont Registration Number 30,996; Steven B. Kelber, Registration Number 30,073; Robert F. Gnuse, Registration Number 27,295; Jean-Paul Lavallee, Registration Number 31,451; Stephen G. Baxter, Registration Number 32,884; Martin M. Zoltick, Registration Number 35,745; Robert W. Hahl, Registration Number 33,893; Richard L. Treanor, Registration Number 36,372; Steven P. Weihrouch, Registration Number 32,829; John T. Goolkasian, Registration Number 26,142; Mare R. Labgold, Registration Number 34,651; William J. Healey, Registration Number 36,160; Richard L. Chinn, Registration Number 34,305; Steven E. Lipman, Registration Number 30,011; Carl E. Schlier, Registration Number 34,426; James J. Kulbaski, Registration Number 31,648; Catherine B. Richardson, Registration Number 39,007; Richard A. Neifeld, Registration Number 35,299; and J. Derele Mason, Registration Number 35,270; and Surinder Sachar, Registration Number 34,423, with full powers of substitution and revocation.

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唯一または第一発明者		Full name of sole or first inventor <u>Hideki KINUGAWA</u>	
発明者の署名	日付	Inventor's signature <u>Hideki Kinugawa</u> Date <u>October 1, 2000</u>	
住所	Residence c/o <u>KOBELCO CONSTRUCTION MACHINERY CO., LTD.</u> 12-4, Gion 3-chome, Asaminami-ku, Hiroshima-shi, Hiroshima Japan <u>99</u>		
国籍	Citizenship JP		
私書箱	Post Office Address SAME AS ABOVE		
第二共同発明者		Full name of second joint inventor, if any <u>Masayuki KOMIYAMA</u>	
第二共同発明者の署名	日付	Second Inventor's signature <u>Masayuki Komiyama</u> Date <u>October 1, 2000</u>	
住所	Residence c/o <u>KOBELCO CONSTRUCTION MACHINERY CO., LTD.</u> 12-4, Gion 3-chome, Asaminami-ku, Hiroshima-shi, Hiroshima Japan <u>99</u>		
国籍	Citizenship JP		
私書箱	Post Office Address SAME AS ABOVE		

(第三以降の共同発明者についても同様に記載し、署名すること)。

Supply similar information and signature for third and subsequent joint inventors.)

Japanese Language Declaration

(日本語宣言書)

第三共同発明者		Full name of third joint inventor, if any <u>Hirokazu ARAYA</u>
第三共同発明者の署名	日付	Third Inventor's signature <u>Hirokazu Araya</u> Date <u>October 1, 2000</u>
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第四共同発明者		Full name of fourth joint inventor, if any <u>Masayuki KAGOSHIMA</u>
第四共同発明者の署名	日付	Fourth Inventor's signature <u>Masayuki Kagoshima</u> Date <u>October 1, 2000</u>
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第五共同発明者		Full name of fifth joint inventor, if any
第五共同発明者の署名	日付	Fifth Inventor's signature Date
住所	Residence	
国籍	Citizenship	
郵便の宛先	Post Office Address	

第六共同発明者		Full name of sixth joint inventor, if any
第六共同発明者の署名	日付	Sixth Inventor's signature Date
住所	Residence	
国籍	Citizenship	
郵便の宛先	Post Office Address	

(第六またはそれ以降の共同発明者についても同様な
情報および署名を提供すること。)

(Supply similar information and signature for sixth and
subsequent joint inventors.)